Consumer Preferences for Sirloin Steak: The Influence of Tasting

Myriah D. Johnson  
Texas A&M University  
The Agricultural & Food Policy Center  
Department of Agricultural Economics  
2124 TAMU/353 AGLS Building  
College Station, TX 77843-2124  
myriabjohnson@tamu.edu  
979.845.5913

David P. Anderson  
Texas A&M University  
The Agricultural & Food Policy Center  
Department of Agricultural Economics  
2124 TAMU/330C AGLS Building  
College Station, TX 77843-2124  
danderson@tamu.edu  
979.845.4351

Marco A. Palma  
Texas A&M University  
Department of Agricultural Economics  
2124 TAMU/330D AGLS Building  
College Station, TX 77843-2124  
mapalma@tamu.edu  
979.845.5284

Jason E. Sawyer  
Texas A&M University  
Department of Animal Science  
2471 TAMU/Kleberg 133  
College Station, TX 77843-2471  
j-sawyer@tamu.edu  
979.862.7679

Rhonda K. Miller  
Texas A&M University  
Department of Animal Science  
2471 TAMU/Kleberg 310  
College Station, TX 77843-2471  
rmiiller@tamu.edu  
979.845.3901

Tryon A. Wickersham  
Texas A&M University  
Department of Animal Science  
2471 TAMU/Kleberg 230  
College Station, TX 77843-2471  
tryon@tamu.edu  
979.862.7088

Jessie C. Morrill  
Texas A&M University  
Department of Animal Science  
2471 TAMU/Kleberg 017B  
College Station, TX 77843-2471  
jhoffman1@tamu.edu  
979.845.2651

James W. Richardson  
Texas A&M University  
The Agricultural & Food Policy Center  
Department of Agricultural Economics  
2124 TAMU/351C AGLS Building  
College Station, TX 77843-2124  
jwrichardson@tamu.edu  
979.845.5913


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Abstract

The objective of this research was to determine consumer preferences for tenderness, quality grade, origin, use of growth technologies, and price of beef, sirloin steak, specifically. Two hundred twenty three consumers participated. Of these, 96 consumers participated in a sensory tasting panel for sirloin steak before completing a choice set survey while the remaining 127 completed the choice set survey. A structural difference was found in the results between the two groups. The eating experience was found to be critical, altering the preferences of consumers. Consumers overstated their willingness-to-pay (WTP) for credence attributes before tasting the product. After tasting products, factors that influence the eating experience (tenderness, quality grade) still dominated as the most important and influential attributes on WTP. The lack of WTP premium or discount from the no tasting group for beef quality grade may indicate a lack of knowledge about the meaning of the grade terms “choice” and “select.” Sensory panel participants reported a significant WTP premium for Choice indicating they value that quality when they eat it. The use of no hormones and no antibiotics in production had a premium of $2.34/kg among the no tasting group, but after tasting the premium was reduced to $1.19/kg.

Key Words: Consumer Willingness-to-Pay (WTP), Beef, Consumer Preference, Discrete Choice Experiment, Cattle
Consumer Preferences for Sirloin Steak: The Influence of Tasting

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Introduction

Several studies have been conducted examining consumer preference for beef over a wide range of product attributes. However, few studies have included tasting, or experience with the product. Lusk et al. (2001) observed an increased willingness-to-pay (WTP) for steaks when consumers were allowed to sample the steak product versus when they were not. Before implementation, Loureiro and Umberger (2003) observed an increase in WTP by an average of $3.37/kg for steak labeled as “U.S. Certified Steak”, over the initial given price. Conversely, after country-of-origin labeling (COOL) implementation, the United States Department of Agriculture (USDA; 2015) found little to no evidence of a measurable increase in consumer demand for beef due to COOL implementation. Thus, the influence of taste or experience may be important in determining consumers WTP for beef attributes.

Credence attributes, or perceived benefits, are unobserved by consumers even after consumption. They include products that have local, health, environmental, and quality claims. Products are often marketed under such claims, especially when it is believed that such claims will increase consumer acceptance and willingness-to-pay for the product.

Our objective was to describe consumer preferences for beef by conducting a discrete choice experiment (DCE) with consumers offered sirloin steaks. We hypothesized that participants who have the opportunity to taste steak samples will have different preferences than participants who do not taste the steak product. Those without a tasting opportunity will only
have information about the steak product, while the tasting group has both the information and
direct experience with the product. We hypothesized that consumers who have this experience
will be willing to pay more for physical attributes than consumers without experience.

Materials and Methods

Consumer participant consent

Study procedures were approved by the Institutional Review Board of Texas A&M
University for research involving human subjects. Prior to participation in this study, consumer
participants were asked to read and sign a consent form as required by the Texas A&M
University Institutional Review Board. Participation was contingent on the individual signing
the consent form.

Consumer sensory panel sample preparation

Electric griddles (Model 072306, National Presto Ind., Inc., Eau Claire, WI), set at 191
°C were used to cook steaks. Frozen sirloin steaks were thawed for approximately 24 h before
cooking. After cooking, steaks were cut into 1.25 cm × 1.25 cm portions and fed to the panelists.

Consumer sensory panel methods

For the sensory panel, a total of 96 participants were recruited from the Bryan-College
Station area of Texas. To qualify for the study, participants had to be at least 18 years of age and
consume beef as a normal part of their diet. When recruited, panelists were told they would
consume beef as a part of the study. Participants were scheduled for participation in one of four
evaluation sessions. Evaluation sessions were held for 2 d with 2 sessions per day, targeting 24
consumers/session. Sensory panel sessions were performed in the Sensory Testing facility at
Texas A&M University (College Station) in January 2015.
Before being seated, participants were given verbal instructions regarding ballots and sampling procedures. Participants were seated randomly in separate booths to prevent communication between panelists. Booths with red filtered lights were used to mask color variation among samples. After seating, the panelists were asked to answer a demographic and meat consumption survey. All panelists were provided with an attribute description sheet (Appendix). In two of the sessions, the panelists received the attribute description sheet before product tasting, while in the other two sessions panelists received the attribute description sheet after product tasting. The attribute description sheet was given both before and after so the effect of the attribute description sheet would be balanced and could be accounted for, as this was not the focus of the research.

Panelists were provided double-distilled, deionized water and unsalted crackers. Panelists were instructed to take a bite of cracker followed by a drink of water between samples to cleanse their palates. After sampling, panelists were asked to complete the choice set survey. The choice set survey consisted of eighteen different choice sets. Each choice set consisted of three hypothetical steaks, with different product attributes, and an opt-out “none of the products” option. Panelists were asked to select which product they would purchase, as if they were facing these choices in a supermarket. After completion of the study, all participants received a compensation fee of $30.

Retail market panel methods

For the retail market panel, a total of 127 participants were recruited at a local retail market store in the Bryan-College Station area of Texas. To qualify for the study, participants had to be at least 18 years of age and consume beef as a part of their diet.
Panelists were given the product attribute description sheet, demographic and meat consumption survey, and choice set survey to complete. These surveys were the same as the surveys given to the participants in the consumer sensory panel. The only difference between the two panels was that in the retail setting, participants did not have the chance to taste the steak product. Additionally, participants in the retail market panel were not compensated.

Basic demographics of all 223 participants, along with those of the U.S. population, according to the American Community Survey (USCB, 2013), are found in Table 1.1.

**Discrete choice experiment**

A discrete choice experiment was conducted to elicit preferences for meat products. The decision to use a hypothetical choice experiment was made because beef with the product attribute combinations presented are not currently available in retail markets. As mentioned previously, each choice set consisted of three hypothetical product choices (steaks), with different attributes, and one opt-out alternative labeled as “none of the products” alternative. The hypothetical choices consisted of five different attributes, with three levels each. The five different attribute categories were tenderness (extremely tender, tender, not tender), USDA Quality Grade (Prime, Choice, Select), origin (imported, domestic, local), growth technology (hormones, antibiotics, no hormones or antibiotics), and price ($3/lb, $5/lb, $7/lb {6.61/kg, 11.02/kg, or 15.43/kg}). The exact description of each attribute level is included in the product attribute description section of the Appendix. Thus, there were $3^5 = 243$ different steak combinations that could be described. It is burdensome and impractical to ask panelists to answer such a large number of product selections. Therefore, a fractional factorial D-efficient design with no priors was constructed in Ngene 1.1.2 (Ngene 2014; Sydney, Australia). The final design consisted of 18 choice sets with a D-error of 0.111. Each choice set contained three...
product alternatives plus an opt-out no purchase option. The inclusion of the opt-out option was chosen to more accurately resemble a real-life purchasing situation where a consumer may choose not to purchase any of the available alternatives.

For the purpose of estimation, quality grade, origin, and growth technology were treated as discrete variables, while tenderness and price were treated as continuous variables. The choice set survey results were coded using effects coding. In effects coding, with \( L \) number of attributes, \( L-1 \) attributes are used, similar to dummy variable coding (Bech and Gyrd-Hansen, 2005). For dummy coding, 0 is used as the reference level, while in effects coding -1 is the reference level. Thus, the reference point is internalized in the parameter coefficient estimates and not represented in the intercept parameter estimate (Williams, 1994).

The methodology of Palma et al. (2014) was followed for this experiment. STATA 13.1 (StataCorp; College Station, TX) was used to estimate the mixed logit model. All product attributes were modeled in a random parameter framework. The model was estimated for all participants, and separated by participants who tasted the beef products, and participants who did not taste the beef products.

A pooling test was conducted to see if the parameter estimates differed structurally for those who tasted the product versus those who did not. The pooling test, based on the likelihood ratio was calculated as follows:

\[-2 \times [\log - \text{likelihood value of all respondents} + (\log - \text{likelihood value of tasting respondents} + \log - \text{likelihood value of no tasting respondents})].\]

Coefficients of the product attributes from the consumer choice model were converted to mean WTP values. The standard deviations of the estimated coefficients were used to estimate a range of WTP using the delta method by Taylor’s approximations series with a 95% confidence
interval. These values were obtained under the Ceteris Paribus assumption, which means that each WTP estimate assumes that the WTP dollar amount calculated was for two products identical in all respects other than the specified attribute of comparison.

**Results and Discussion**

Primary shoppers dominated the respondent group (78%). Survey respondents came from an average household size of 2.49 individuals with an average income of $53,824 (Table 1.2). Food expenditures represented 12.80% of household income across all participants, 14.26% for the tasting respondents, and 11.77% for the no tasting respondents. Meat expenditures across all respondents, tasting, and no tasting respondents were 3.5%, 3.62%, and 3.39% of household income, respectively. Beef expenditures were 1.99% of income across all respondents, 2.15% for the tasting respondents, and 1.86% for the no tasting respondents.

Three different models were estimated. The first model included data from all respondents, the second only from respondents who had tasted the beef products, and the third included data only from respondents who had not tasted the beef products. Respondents who had not tasted the product represent consumers who are faced with a novel product when making purchasing decisions, in a retail setting. Their decisions are based on available information, but not experience. Once they purchase the product and consume it, their preferences are ‘updated’ with their experience with the product, and this may alter their preferences and repurchase of the products. The respondents who tasted the product prior to executing the discrete choice survey represent consumers whose experience has been ‘updated’ in this manner.

The log likelihood values for each of the 3 models were used in conducting the pooling test for structural changes. The parameter estimates of individuals who tasted the beef product differed structurally from those who did not taste the beef product ($P < 0.01$). Because the
tasting and no tasting participants were structurally different, the results for the overall (or pooled) sample population are not reported.

Table 1.3 displays the mixed logit parameter estimation results. The model was estimated for each panelist. The parameter estimate for each attribute is the mean parameter estimate across all participants in the group. The standard error of the parameter estimate is shown in parentheses below the estimate. The standard deviation of the group’s response is also listed in Table 1.3. The statistical significance of the standard deviations indicates the presence of preference heterogeneity for the measured beef attributes. This heterogeneity indicates that tastes and preferences towards production method, growth technologies, and price vary across respondents within a group (tasting/no tasting). If preferences are homogeneous, then tastes and preferences are the same among all respondents, or the same attributes are important to all respondents. Another way to think of this is if the standard deviation is small, or there is little variation among participants, then preferences are homogeneous and consumers have similar preferences for the specified attribute. On the other hand, if the variance is wide among participant’s responses, then there is heterogeneity, or consumers have a wide variation in preferences for the attribute in question.

Preferences were heterogeneous within both respondent groups for not tender as compared to tender, quality grade prime compared to quality grade choice, and origin, imported versus domestic. Preferences are also heterogeneous for the tasting group for quality grade select versus quality grade choice, indicating that within this group, there were different preferences for each quality grade, and that some respondents may have been indifferent to quality grade. For the no tasting group, preferences are heterogeneous for tenderness, extremely tender versus tender. Notably, preferences are homogeneous (preferences do not vary across
respondents within the group) for the extremely tender attribute in the tasting group and for the quality grade select attribute in the no tasting group. The local origin attribute is homogeneous across both the tasting and no tasting groups.

In practical terms, heterogeneous preferences mean that consumers are different and prefer different things. For example, some consumers may prefer quality grade prime beef while others prefer quality grade choice beef. This reality affords the opportunity for differentiated products or niche products in the market. Homogenous preferences suggest that all consumers prefer the same attribute. In this survey, all consumers expressed a preference for beef of local origin (defined in this study as cattle raised, fed, and harvested within a 644 kilometer \{400 mile\} radius of the retail location) as compared to beef of domestic origin. When tastes and preferences are homogenous then the same marketing strategy is likely to be effective across all consumers.

The negative sign and statistical significance of the no-product constant indicates that consumers were inclined to choose one of the products instead of choosing the no product option (Table 1.3). The willingness-to-pay (WTP) estimates shown graphically in Figures 1.1 and 1.2 for the tasting respondents and no tasting respondents, respectively. Additionally, WTP estimates for all attributes evaluated are contained in Table 2.1 of the Appendix in U.S. dollars per kilogram at the retail level.

When the consumers for the tasting group were recruited, they were told they would consume beef as a portion of the study. Knowing this up front may have influenced their decision of whether to participate or not. Thus, it is probable that consumers in the tasting group had a stronger preference for beef than consumers in the no tasting group.
For tenderness, the non-tender attribute was negative and statistically significant for both
tasting and no tasting groups. However, the magnitude increased in the tasting sample (-
$2.12/kg for no tasting versus -$7.45/kg with tasting). Similarly, but on the positive side,
extremely tender went from a $1.41/kg premium in the no tasting to $4.83/kg premium with
tasting. Thus indicating that consumers may not think tenderness is very important or that there
is little difference among tenderness levels, but consumers can differentiate and it affects WTP.
The 2010 National Beef Tenderness Survey (Guelker et al., 2013) found that most steaks
evaluated in their study from retail and foodservice were considered tender. This supports the
idea that consumers may think there is little difference among tenderness since they do not
generally find differences among the products they purchase. Similar to these results Lusk et al.
(2001) found that consumers were willing to pay a premium of $2.71/kg for a tender versus
tough steak. That value increased to $4.06/kg after the consumers completed a taste test. Fuez et
al. (2004) also found that consumers are willing to pay a premium for more tender steaks,
regardless of USDA quality grade.

Preference for Prime quality grade was not statistically different than zero in the no
tasting group, but did generate a price premium of $1.23/kg in the tasting group. Additionally,
preference for the Select quality grade was not different than zero in the no tasting group, but did
generate a price discount of -$1.59/kg among the tasting group. The quality grade of the steak
samples was not disclosed to the participants of the tasting group. Even so, the tasting group had
different preferences for the quality grades than the no tasting group. This further highlights that
the two tasting groups are different and do not have similar preferences, and may reinforce the
suggestion that voluntary participants in the tasting group may have a generally higher level of
experience with beef products or more firmly established preferences for specific attributes.
The results observed for the quality grade attributes reinforce those observed for the
tenderness attributes. Consumers who did not taste the beef product tended to discount the
importance of tenderness and quality grade, but those consumers who did taste the beef product
found it to be much more important. The lack of WTP premium or discount for beef quality
grade may indicate a lack of knowledge about the meaning of choice and select grade beef, but
upon eating the product consumers can tell a difference. Additionally, this provides information
about consumers making purchasing decisions at the grocery store without tasting the products.
They can be likened to the no tasting group. However, when these people purchase a product at
the store and then take them home, cook, and taste them, then they become similar to the tasting
group. If there is truly a lack of knowledge among consumers about quality grade, then
emphasis on quality grade as a market differentiation attribute may be ineffective. This idea is
supported by the work of DeVuyst et al. (2014) where they found substantial confusion over
quality grading nomenclature among consumers. They suggested a transition towards more
descriptive terminology at the retail level. Thus, indications about the level of tenderness and
juiciness may be more effective than listing the quality grade of the meat, even though they are
intended to convey the same information.

At the time of this experiment, the retail market placed a $0.88/kg premium on Choice
top sirloin steaks over Select (Livestock Marketing Information Center [LMIC], 2015).
However, consumers in this project who did not taste the product (like consumers in a grocery
store) did not place any value on the product being of Choice quality grade versus Select. If beef
products were marketed in a manner that consumers better understood, such as guaranteed
tender, then companies may be able to capture the more than $1/kg price premium indicated by
the consumers who tasted the product. Quality grade may still be an efficient tool for marketing
beef in the production chain, just not to the end consumer. Killinger et al., (2004), evaluated the preference of consumers for steaks that differed in marbling (high = upper 2/3 USDA Choice, low = USDA Select). Overall, they found that consumers found high-marbled steaks to be more acceptable than low-marbled steaks in flavor and overall acceptability when tenderness differences were minimized. Ultimately, however, consumers were willing to pay more for their preference, whether that was for high-marbled or low-marbled steaks. Fuez, et al., (2004), also evaluated the impact of USDA quality grade on WTP values. They found that marbling, the primary determinant of USDA beef quality grades, did not significantly impact panelists’ WTP values.

Beef origin had similar directional results among both the tasting and no tasting groups with some differences in magnitude. In the current study, origin was defined as “imported,” “local,” or “domestically” produced beef (Product Attribute Descriptions, Appendix). Imported beef was discounted -$1.37/kg on average by the no tasting group and by -$2.51/kg by the tasting group relative to domestic. “Local” beef had price premiums relative to domestic of $0.73/kg by the no tasting group and $1.37/kg by the tasting group. These results were similar to other origin focused studies that found an increased WTP for domestic and local beef products. Maynard et al., (2003), determined that 52% of participants in their study expressed a WTP premium of 20% for locally produced steak over undifferentiated USDA Choice steak. Li, et al., (2015), also found that consumers are willing to pay $3.62/kg more for a local steak product. Lim, et al., (2011), reported that U.S. consumers are willing to pay a premium for strip loin steaks from the U.S. compared to Canada or Australia. Those authors noted that age and education of respondents were significant factors in the preference of origin, with older consumers more strongly preferring steak of domestic-origin, while this preference is more moderate among
consumers with higher education levels. Mutondo and Henneberry (2007) found that U.S. grain-fed beef had a competitive advantage in the domestic market over imported beef from Australia, Canada, and New Zealand using the Rotterdam model. Lastly, Abidoye et al., (2011), found in their online survey a discount of -$4.43/kg of beef when it was not produced in the United States. In all of these studies there was not a comparison between experience (tasting) of the product and no experience. With a tasting experience, the results in each of these studies may have been changed.

Conversely, the USDA economic analysis of COOL (USDA; 2015) reported that there was little to no evidence of a measurable increase in consumer demand for beef due to COOL implementation. So even though USDA’s regulatory impact analyses indicated substantial interest in COOL, it did not result in measurable increases in market-level consumer demand. Conclusions from the USDA (2015) report suggest that results from the current study should be interpreted cautiously; although consumers in the current study indicated an increased WTP for local or domestic products compared to imported products, these premiums may not be realized in the market. Perhaps the unrealized difference in demand was due to experience versus perception. When the USDA conducted the impact analysis there was no experience, only perception, but after implementation perception could have been changed by experience, as it was in the current study.

No hormones and no antibiotics had a premium of $2.34/kg among the no tasting group, but after tasting, the premium was reduced to $1.19/kg. The use of hormones as a growth technology had price discounts of -$1.23/kg in the no tasting group, but was not statistically different than zero in the tasting treatment. Abidoye et al., (2011), using an online survey, found a WTP premium of $1.68/kg when no growth promotants were utilized.
Overall, consumers tend to overstate their WTP with purely hypothetical choices related to credence attributes, and place more weight on physical attributes when they taste the product. This suggests that taste is the dominant attribute; consumers may have preferences or at least express preference for credence attributes, but taste can alter or reduce these expressed preferences. In the 2011 National Beef Quality Audit researchers evaluated the WTP across market sectors of several meat characteristics, one of these being eating satisfaction. For their study, eating satisfaction was most often described as flavor and tenderness by participants. They found that eating satisfaction was the only quality category for which Packers, Food Service buyers, and Retailers were willing to pay a premium, thus supporting the idea that physical attributes dominate. Willingness to pay may be increased for favorable physical attributes or, in other words, reduce their “dislike” to certain credence attributes in favor of “taste.” Credence attributes are product characteristics that consumers are unable to evaluate or verify even after consuming the products without incurring excessively high information costs (Wirth, Love, and Palma, 2007; Lusk, 2013). Origin and growth technology are credence attributes. According to Lusk, et al., (2003) choice experiments operate on the assumption that consumers derive utility from consuming the product attributes rather than the product itself. This implies that the panelists who did not taste the beef product derived utility from stating that they would pay more for the credence attributes as compared to the panelists who did taste the products.

Conclusions

This work highlights some critical points about the WTP for beef attributes. The eating experience alters the preferences of consumers. Perception of WTP attributes are different once consumers taste beef that has those attributes. Consumer’s pre-conceived notions of a value and
what they place value on may change drastically when they consume the product. Some attributes may become more valuable, as observed for tenderness. A very tender steak is even more valued after a consumer samples one, and a tough one is discounted even more. This observation has implications for creating stability of demand for premium products that offer a tenderness guarantee.

Consumers seem to overstate their WTP for credence attributes. After tasting products, factors that influence the eating experience still dominate as the most important and influential attributes on WTP. If producers can find a way to deliver on the credence attributes while not decreasing the eating experience of the meat then they will be able to command the highest premium of all.
REFERENCES


Table 1.1. Demographic Characteristics of Survey Respondents (n=223) and U.S. Population.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>Sample Mean</th>
<th>Sample Std. Dev.</th>
<th>%</th>
<th>U.S. (a) %</th>
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<tbody>
<tr>
<td>Age (years)</td>
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<td>19.26</td>
<td>37.5</td>
<td>41.2%</td>
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<td>Education</td>
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<td></td>
<td>7.7%</td>
<td>41.2%</td>
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<td></td>
<td>4-year College Degree or Less</td>
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<tr>
<td></td>
<td>Graduate Courses or More</td>
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<td></td>
<td>30.8</td>
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<tr>
<td>Household Size</td>
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<td>1.32</td>
<td>2.63</td>
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<td>(Number of Individuals)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Gender</td>
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<tr>
<td></td>
<td>Not Married</td>
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<td>57.5%</td>
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<td>$25,271</td>
<td>$73,767</td>
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(a) Source: U.S. Census Bureau, 2013 American Community Survey
Table 1.2. Food Expenditures and Other Characteristics of Interest of Survey Respondents.

<table>
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<th>Variable</th>
<th>Tasting Respondents</th>
<th>No Tasting Respondents</th>
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<tr>
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<td>Sample Mean</td>
<td>Sample Std. Dev.</td>
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<td>2.81 1.45</td>
<td>2.25 1.16</td>
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<tr>
<td>Income</td>
<td>$51,823 $27,359</td>
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<td>Weekly Food Expenditures</td>
<td>$142.09 $110.43</td>
<td>$125.38 $81.80</td>
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<tr>
<td>Food Expenditures as a Percentage of Income</td>
<td>14.26%</td>
<td>11.77%</td>
</tr>
<tr>
<td>Weekly Meat Expenditures</td>
<td>$36.08 $22.51</td>
<td>$36.20 $28.56</td>
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<tr>
<td>Meat Expenditures as a Percentage of Income</td>
<td>3.62%</td>
<td>3.39%</td>
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<td>Weekly Beef Expenditures</td>
<td>$21.47 $15.55</td>
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<td>Beef Expenditures as a Percentage of Income</td>
<td>2.15%</td>
<td>1.86%</td>
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<tr>
<td></td>
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<td>of Random Parameters</td>
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<td>-1.59***</td>
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<tr>
<td></td>
<td>(0.18)</td>
<td>(0.13)</td>
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<td>Not Tender</td>
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<td>-0.89***</td>
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<tr>
<td></td>
<td>(0.10)</td>
<td>(0.08)</td>
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<td>Extremely Tender</td>
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<td>0.59***</td>
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<tr>
<td>Tender</td>
<td>(0.07)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>Quality</td>
<td>0.24***</td>
<td>-0.03</td>
</tr>
<tr>
<td>Grade Prime</td>
<td>(0.07)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>Quality</td>
<td>-0.31***</td>
<td>-0.04</td>
</tr>
<tr>
<td>Grade Select</td>
<td>(0.07)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>Imported</td>
<td>-0.49***</td>
<td>-0.57***</td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>Local</td>
<td>0.26***</td>
<td>0.30***</td>
</tr>
<tr>
<td></td>
<td>(0.05)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>No Hormones or</td>
<td>0.23***</td>
<td>0.98***</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>(0.07)</td>
<td>(0.10)</td>
</tr>
<tr>
<td>Price</td>
<td>-0.02</td>
<td>-0.52***</td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>No. Observations</td>
<td>6,860</td>
<td>9,132</td>
</tr>
<tr>
<td>Participants</td>
<td>96</td>
<td>126</td>
</tr>
<tr>
<td>Log Likelihood</td>
<td>-1,592.41</td>
<td>-2,205.94</td>
</tr>
</tbody>
</table>

1Single (*), double (**), and triple (*** ) asterisk are used to denote significance at the 0.10, 0.05, and 0.01 levels, respectively. Standard errors are listed below each estimate in parentheses.
Figure 1.1. Willingness-to-pay estimates in dollars per kilogram for beef attributes. Error bars represent the standard error or the estimates.
Figure 1.2. Willingness-to-pay estimates for no tasting respondents in dollars per kilogram for beef attributes. Error bars represent the standard error or the estimates.
Appendix

Product Attribute Descriptions

1) **Tenderness** in beef is defined as being easily able to chew the piece of beef.
   - **Not Tender** - A properly prepared steak was difficult to chew and failed to provide a positive eating experience.
   - **Tender** - A properly prepared steak was easily chewed and provided a positive eating experience.
   - **Extremely Tender** - A properly prepared steak was very easily chewed and provided an extremely positive eating experience.

2) **Quality Grade**

   A quality grade is a composite evaluation of factors that affect the tenderness, juiciness, and flavor of beef. Beef grade is based on degree of marbling.

   ![Prime](image1)
   ![Choice](image2)
   ![Select](image3)

   - **Prime** - Marbling is moderately abundant.
   - **Choice** - Marbling is modest.
   - **Select** - Marbling is slight.

3) **Origin**

   - **USA** - Cattle were raised, fed, and harvested within the U.S.A.
   - **Local** - Cattle were raised, fed, and harvested within a 400 mile radius of the retail location.
   - **Imported** - Cattle were raised, fed, and harvested internationally.

4) **Growth Technology**

   - **None** - No hormones or antibiotics were used in the production of this animal.
   - **Hormone** - Hormones were administered to these animals to promote their growth within the guidelines set by the U.S. Food and Drug Administration (FDA).
   - **Antibiotic** - Antibiotics were administered to these animals whenever they displayed symptoms of illness within the guidelines set by the U.S. Food and Drug Administration (FDA).

5) **Price**

   - The price of the beef is $3.00/lb, $5.00/lb or $7.00/lb ($6.61/kg, $11.02/kg, or $15.43/kg).
Table 2.1. Willingness-to-Pay estimates in dollars per kilogram for beef attributes.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Tasting Respondents</th>
<th>No Tasting Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean WTP(^1)</td>
<td>Range WTP(^2)</td>
</tr>
<tr>
<td>Not Tender</td>
<td>-7.45 [-9.59, -5.34]</td>
<td>-2.12 [-2.80, -1.43]</td>
</tr>
<tr>
<td>Extremely Tender</td>
<td>4.83 [3.40, 6.26]</td>
<td>1.41 [0.99, 1.83]</td>
</tr>
<tr>
<td>Quality Grade Prime</td>
<td>1.23 [0.46, 2.01]</td>
<td>-0.09 (^3) [-0.33, 0.18]</td>
</tr>
<tr>
<td>Quality Grade Select</td>
<td>-1.59 [-2.38, -0.82]</td>
<td>-0.11 (^3) [-0.33, 0.13]</td>
</tr>
<tr>
<td>Imported</td>
<td>-2.51 [-3.42, -1.63]</td>
<td>-1.37 [-1.79, -0.93]</td>
</tr>
<tr>
<td>Local</td>
<td>1.37 [0.75, 1.98]</td>
<td>0.73 [0.44, 1.01]</td>
</tr>
<tr>
<td>No Hormones or Antibiotics</td>
<td>1.19 [0.40, 2.01]</td>
<td>2.34 [1.65, 3.02]</td>
</tr>
<tr>
<td>Hormones</td>
<td>-0.11 (^3) [-0.77, 0.57]</td>
<td>-1.23 [-1.68, -0.82]</td>
</tr>
</tbody>
</table>

\(^1\)Indicates that the range of the 95% confidence interval of WTP includes zero.
\(^2\)Calculated using the delta-method using Taylor’s approximation series with a 95% confidence interval.
\(^3\)Indicates that the WTP values are not significant at the 0.05 level.